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Sustainable Management of Mineral Resources—another view on criticality.

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Generally investigations of criticality capture the supply risks on one hand and on the other hand the impact on the economy, the vulnerability to supply disruptions. The classification is a relative one and the analyses are always only a snapshot of a dynamic system: in the seventies of the last century chromium was generally considered the most critical metal. Today others are considered far more critical. These are especially the rare earth and the platinum group elements. Regardless in which direction technology develops these elements together with the steel alloy and electronic metal elements will most probably be the decisive elements to produce the high-tech products necessary for the well-being of Europe in the 21st century. These elements- often in small quantities- have a high economic lever effect. In a new research programme of the German Ministry of Education and Research they have been termed, therefore: economic-strategic raw materials.

This paper will concentrate not so much on the critical materials as such, but on the factors critical in the background, critical to produce them: water, energy and the social acceptance of mining —the license to operate.

From the point of sustainable management of mineral resources an important question with regard to critical aspects is also, how fast and to what extent mankind is able to reactivate the secondary materials in the technosphere to replace resource requirements from the geosphere under the limiting factors to minimize the environmental impact and energy needs. There will always be losses which have to be compensated from the geosphere (thermodynamical impossibility of a 100% closed loop, losses due to different redox potential, losses due to dispersal effects like wear and corrosion), however losses occurring today due to low scrap values can be minimized by better technology. Developments are well under way to replace more and more relative proportions of the major metal needs by material from the technosphere like for steel, aluminium, or copper. Technologies are wanting, however, for many of the materials considered critical or economic-strategic today.